

Curriculum Vitae

Jeffrey Outlaw Shallit

September 16, 2019

(a) NAME:

Shallit, Jeffrey Outlaw

Full professor, tenured

Member of the Graduate Faculty: yes

(b) DEGREES:

Ph.D., University of California, Berkeley, Mathematics, 1983.

AB, Princeton University, Mathematics, 1979, *cum laude*.

(c) EMPLOYMENT HISTORY:

July 2000 - date, Professor, Department of Computer Science, University of Waterloo.

September 1990 - July 2000, Associate Professor (tenured), Department of Computer Science, University of Waterloo.

July 1988 - September 1990: Assistant Professor, Department of Mathematics and Computer Science, Dartmouth College.

September, 1983 - June, 1988: Assistant Professor, Department of Computer Science, University of Chicago.

(d) HONOURS:

Association for Computing Machinery, Distinguished Scientist, October 2008

University of Waterloo, Faculty of Mathematics Award for Distinction in Teaching, September 2011

(e) SCHOLARLY AND PROFESSIONAL ACTIVITIES: past 7 years only (e.g., executive

and editorial positions but not memberships in societies)

2002-date: Editor-in-Chief, *Journal of Integer Sequences*

2009-date: Cognizant Editor, *Information and Computation*

(f) GRADUATE SUPERVISIONS:

Lifetime:

Master's completed, 22.

Ph.D. completed, 5.

Postdoctoral supervision completed, 3.

In progress:

Master's, 2.

Ph. D., 1.

Postdoctoral students: 1.

NAMES OF STUDENTS supervised within the past seven years, title of thesis of project, year of first registration and year of completion:

1. Lukas Fleischer, postdoctoral researcher, June-December 2019.
2. Aseem Raj Baranwal, MMath thesis, started September 2018, continuing.
3. Daniel Gabric, PhD, started September 2018, continuing.
4. Trevor Clokie, MMath thesis, started September 2018, continuing.
5. Samin Riasat, MMath thesis, "Powers and Anti-Powers in Binary Words", started July 2017, completed August 2019.
6. Thomas Finn Lidbetter, MMath thesis, "Counting, Adding, and Regular Languages", started September 2017, completed December 2018.
7. Aayush Rajasekaran, MMath thesis, "Using Automata Theory to Solve Problems in Additive Number Theory", started Fall 2016, completed April 2018.
8. Sajed Haque, MMath thesis, "Discriminators of Integer Sequences", started Fall 2015, completed August 2017.
9. Chen Fei Du, MMath thesis, started Fall 2013, did not complete.
10. Hamoon Mousavi, MMath thesis, "Repetitions in words", started Fall 2011, completed August 2013.

11. Shuo Tan, MMath thesis, “Two results on words”, started Fall 2011, completed August 2013.
12. Luke Schaeffer, MMath thesis, “Deciding properties of automatic sequences”, started Fall 2011, completed August 2013.
13. Daniel Goc, MMath thesis, “Automatic sequences and decidable properties: implementation and applications”, started Fall 2011, completed August 2013.

(g) GRADUATE COURSES: past 7 years

Winter 2019: CS 860, Patterns in Strings

Winter 2017: CS 860, Automatic Sequences

Fall 2013: CS 860, Patterns in Strings

(h)

1. EXTERNAL RESEARCH FUNDING: past 7 years

Jeffrey Shallit, NSERC Discovery Grant, \$41,000 annually, 2008–2013

Jeffrey Shallit et al., Fields Institute Grant, \$5,000 one time, 2012-3, for Fields Workshop April 2013

Jeffrey Shallit, NSERC Discovery Grant, \$36,000 annually, 2013–2018

Jeffrey Shallit, NSERC Discovery Grant, \$36,000 annually, 2018–2023; revised October 2018 to \$48,000 annually, 2018–2023

2. INTERNAL RESEARCH FUNDING: none

i) PUBLICATIONS: The Publications should be listed in the categories shown below and include the following information: books authored, books edited (a list of the chapters contributed by the editor must follow each title), chapters in books (other than those listed in the above category), papers in refereed journals, papers in refereed conference proceedings, technical reports, abstracts and/or papers read, and others. Each title must show the names of the authors in the order in which they appear in the original publication and inclusive page numbers. Publications submitted, but not yet accepted, must be listed separately within the various categories.

(1) Life-time summary (count) according to the following categories:

- books and monographs: 4 written or co-written
- edited books and monographs: 3
- chapters in books and monographs: about 10

- refereed journal articles: about 160
- refereed conference proceedings: about 100
- presentations at conferences: about 70
- technical reports: about 10
- invited/keynote addresses: about 10

(2) Details for past seven (7) years same categories as above: books, chapters in books, papers in refereed journals.

Books authored:

1. *Logical Approach to Automatic Sequences*, contact with Cambridge University Press, 75% complete.
2. Jonathan Borwein, Alf van der Poorten, Jeffrey Shallit, Wadim Zudilin, *Neverending Fractions*, Cambridge University Press, 2014.

Books edited:

1. Stavros Konstantinidis, Nelma Moreira, Rogério Reis, Jeffrey Shallit, eds., *The Role of Theory in Computer Science: Essays Dedicated to Janusz Brzozowski*, World Scientific Press, June 2017. *I served as co-editor of this Festschrift volume and helped with detailed editing of every contribution.*
2. Cezar Câmpeanu, Florin Manea, Jeffrey Shallit, eds., *Descriptive Complexity of Formal Systems (DCFS 2016)*, Bucharest, Romania, July 5-8, 2016. *Proceedings*, Lecture Notes in Computer Science, Vol. 9777, Springer, 2016. (I basically did nothing for this and served as pro-forma editor.)

Chapters in Books:

1. Hermann Gruber, Jonathan Lee, and Jeffrey Shallit, Enumerating regular expressions and their languages, in J.-E. Pin, ed., *Handbook of Automata Theory*, to appear, 2020, 32 pp.
2. Narad Rampersad and Jeffrey Shallit, Repetitions in words, in *Combinatorics, Words and Symbolic Dynamics*, Cambridge University Press, Encyclopedia of Mathematics and Its Applications, Vol. 159, 2016, pp. 101–150.
3. Kevin Ford, Florian Luca, Carl Pomerance, and Jeffrey Shallit, On the parity of the number of small divisors of n , in C. Pomerance and M. Th. Rassias, eds., *Analytic Number Theory*, Springer, 2015, pp. 93–100.

4. J. Shallit, Description of generalized continued fractions by finite automata, in J. M. Borwein, I. Shparlinski, and W. Zudilin, eds., *Number Theory and Related Fields: In Memory of Alf van der Poorten*, Springer-Verlag, 2013, pp. 321–339.

Papers in refereed journals:

1. Daniel M. Kane, Carlo Sanna, and Jeffrey Shallit, Waring’s theorem for binary powers, To appear, *Combinatorica*, 2019.
2. Pierre Bonardo, Anna E. Frid, Jeffrey Shallit, The number of valid factorizations of Fibonacci prefixes, *Theor. Comput. Sci.*, 2019, to appear. Available online at <https://doi.org/10.1016/j.tcs.2018.12.016>.
3. Aayush Rajasekaran, Jeffrey Shallit, and Tim Smith, Additive Number Theory via Automata Theory, *Theor. Comput. Sys.* (2019), 26 pp.
4. Narad Rampersad, Jeffrey Shallit, Élise Vandomme, Critical exponents of infinite balanced words, *Theoret. Comput. Sci.* **777** (2019), 454–463.
5. Jean-Paul Allouche, Samin Riasat, and Jeffrey Shallit, More Infinite Products: Thue-Morse and the Gamma function, *Ramanujan J.* **49** (2019), 115–128.
6. Sajed Haque and Jeffrey Shallit, A class of exponential sequences with shift-invariant discriminators, *Fibonacci Quart.* **57** (2019) 1–9.
7. Lukas Spiegelhofer and Jeffrey Shallit, Continuants, Run Lengths, and Barry’s Modified Pascal Triangle, *Electron. J. Combinatorics* **26** (1) (2019), paper P1.31.
8. Jeffrey Shallit and Ramin Zarifi, Circular critical exponents for Thue-Morse factors, *RAIRO Info. Theor.* **53** (2019) 37–49.
9. J.-P. Allouche and J. Shallit, Michel Mendès France (1936–2018), obituary, in *La Gazette des Mathématiciens* of the Soc. Math. de France, No. 158, October 2018, pp. 81–83.
10. Jason Bell, Kathryn Hare and Jeffrey Shallit, When is an automatic set an additive basis? *Proc. Amer. Math. Soc. Ser. B* **5** (2018), 50–63.
11. Andrew Bridy, Robert J. Lemke Oliver, Arlo Shallit, and Jeffrey Shallit, The Generalized Nagell-Ljunggren Problem: Powers with Repetitive Representations, *Experimental Mathematics*, 2018, 1–12.
12. I. P. Goulden, Andrew Granville, L. Bruce Richmond, Jeffrey Shallit, Natural exact covering systems and the reversion of the Möbius series, *Ramanujan J.*, 2018, <https://doi.org/10.1007/s11139-018-0030-y>.

13. Jeffrey Shallit and Alexander Okhotin: Preface. *Inf. Comput.* **259** (2): 161 (2018). (Not really a research article, just an introduction to the special issue. Listed for completeness.)
14. Guilhem Gamard, Gwénaél Richomme, Jeffrey Shallit, Taylor J. Smith: Periodicity in rectangular arrays. *Inf. Process. Lett.* **118** (2017), 58–63.
15. Yu Hin (Gary) Au, Christopher Drexler-Lemire, and Jeffrey Shallit, Notes and note pairs in Norgard’s infinity series, *J. of Mathematics and Music* **11** (1) (2017) 1–19.
16. Cezar Câmpeanu, Florin Manea, Giovanni Pighizzini, Jeffrey O. Shallit: Preface. *Journal of Automata, Languages and Combinatorics* **22** (1–3): 3–4 (2017). (Not really a research article, just an introduction to the special issue. Listed for completeness.)
17. Chen Fei Du, Hamoon Mousavi, Eric Rowland, Luke Schaeffer, Jeffrey Shallit: Decision algorithms for Fibonacci-automatic words, II: Related sequences and avoidability. *Theor. Comput. Sci.* **657**: 146–162 (2017).
18. Robbert Fokkink, Cor Kraaikamp, and Jeffrey Shallit, Hankel matrices for the period-doubling sequence, *Indag. Math.* **28** (2017), 108–119.
19. Gabriele Fici, Filippo Mignosi, Jeffrey Shallit: Abelian-square-rich words. *Theor. Comput. Sci.* **684**: 29–42 (2017).
20. Luke Schaeffer and Jeffrey Shallit: Closed, Palindromic, Rich, Privileged, Trapezoidal, and Balanced Words in Automatic Sequences. *Electr. J. Comb.* **23** (1): P1.25 (2016).
21. Dzmityry Badziahin and Jeffrey Shallit, An unusual continued fraction, *Proc. Amer. Math. Soc.* **144** (2016), 1887–1896.
22. Curtis Bright, Raymond R. Devillers, Jeffrey Shallit: Minimal Elements for the Prime Numbers. *Experimental Mathematics* **25**(3) (2016), 321–331.
23. Sajed Haque and Jeffrey Shallit, Discriminators and k -regular sequences, *INTEGERS* **16** (2016), Paper #A76.
24. Chen Fei Du, Hamoon Mousavi, Luke Schaeffer, and Jeffrey Shallit: Decision algorithms for Fibonacci-automatic words, III: Enumeration and abelian properties. *Int. J. Found. Comput. Sci.* **27** (2016), 943–964.
25. Michael Forsyth, Amlesh Jayakumar, and Jarkko Peltomäki, Jeffrey Shallit: Remarks on Privileged Words. *Int. J. Found. Comput. Sci.* **27** (2016), 431–442.
26. Chuan Guo, Jeffrey Shallit, and Arseny M. Shur: Palindromic rich words and run-length encodings. *Inf. Process. Lett.* **116** (2016), 735–738.

27. Hamoon Mousavi, Luke Schaeffer, and Jeffrey Shallit: Decision algorithms for Fibonacci-automatic Words, I: Basic results. *RAIRO - Theor. Inf. and Applic.* **50** (2016), 39–66.
28. Chen Fei Du, Jeffrey Shallit, and Arseny M. Shur, Optimal Bounds for the Similarity Density of the Thue-Morse Word with Overlap-Free and $7/3$ -Power-Free Infinite Binary Words, *International J. of Foundations of Computer Science* **26** (8) (2015) 1147–1165.
29. J. Shallit, Enumeration and Automatic Sequences, *Pure Mathematics and Applications* **25** (1) (2015), 96–106.
30. Eric Rowland and Jeffrey Shallit, Automatic sets of rational numbers, *Int. J. Found. Comput. Sci.* **26** (2015), 343–365.
31. Julien Cassaigne, James D. Currie, Luke Schaeffer, and Jeffrey Shallit, Avoiding Three Consecutive Blocks of the Same Size and Same Sum, *J. ACM* **61** (2) (2014), Paper 10, 17 pages.
32. L. Bruce Richmond and J. Shallit, Counting the palstars, *Electronic J. Combinatorics* **21** (3) (2014), Paper #P3.25.
33. Kevin Hare, Helmut Prodinger, and Jeffrey Shallit, Three Series for the Generalized Golden Mean, *Fibonacci Quarterly* **52** (4) (2014), 307–313.
34. Alexander Leong and Jeffrey Shallit, Counting sequences with small discrepancies. *Experimental Mathematics* **22** (2013), 74–84. 2012 Impact Factor: 0.731.
35. D. Goč, D. Henshall, and J. Shallit, Automatic theorem-proving in combinatorics on words, *Int'l. J. Found. Comput. Sci.* **24** (2013), 781–798. (2012 Journal Impact Factor: 0.38)
36. Hamoon Mousavi and Jeffrey Shallit, Filtrations of formal languages by arithmetic progressions. *Fundam. Inform.* **123** (2013), 135–142. 2012 Impact Factor: 0.399.
37. Emilie Charlier, Michael Domaratzki, Tero Harju, and Jeffrey Shallit, Composition and orbits of language operations: finiteness and upper bounds. *Int. J. Comput. Math.* **90** (2013), 1171–1196. 2012 Impact Factor: 0.542.
38. Luke Schaeffer and Jeffrey Shallit, The critical exponent is computable for automatic sequences, *Int. J. Found. Comput. Sci.* **23** (2012), 1611–1626. (2012 Journal Impact Factor: 0.38)
39. Chiara Epifanio, Christiane Frougny, Alessandra Gabriele, Filippo Mignosi, and Jeffrey Shallit, Sturmian graphs and integer representations over numeration systems, *Discrete Applied Mathematics* **160** (2012), 536–547.

40. E. Charlier, N. Rampersad, and J. Shallit, Enumeration and decidable properties of automatic sequences, *Int. J. Found. Comput. Sci.*, **23** (2012), 1035–1066. (2012 Journal Impact Factor: 0.38)
41. Narad Rampersad, Jeffrey Shallit, and Zhi Xu, The computational complexity of universality problems for prefixes, suffixes, factors, and subwords of regular languages. *Fundam. Inform.* **116** (1–4) (2012), 223–236. (2011 Journal Impact Factor: 0.365)
42. Jean-Paul Allouche and Jeffrey Shallit, A variant of Hofstadter’s sequence and finite automata, *J. Aust. Math. Soc.* **93** (2012), 1–8.
43. E. Rowland and J. Shallit, Avoiding $3/2$ -powers over the natural numbers, *Discrete Math.* **312** (2012), 1282–1288. (2012 Journal Impact Factor: 0.556)

Papers in refereed conference proceedings:

1. Tim Ng, Pascal Ochem, Narad Rampersad, and Jeffrey Shallit, New results on pseudosquare avoidance, arxiv preprint, April 19 2019. To appear in *WORDS 2019*.
2. Aseem R. Baranwal, Jeffrey Shallit, Critical exponent of infinite balanced words via the Pell number system, arxiv Preprint, February 1 2019. To appear in *WORDS 2019*.
3. Aseem Raj Baranwal, Jeffrey Shallit, Repetitions in infinite palindrome-rich words, arxiv preprint, April 22 2019. To appear in *WORDS 2019*.
4. T. Clokie, D. Gabric, and J. Shallit, Circularly squarefree words and unbordered conjugates: a new approach, arxiv preprint, April 17 2019. To appear in *WORDS 2019*.
5. D. Gabric, S. Holub, and J. Shallit, Generalized de Bruijn words and the state complexity of conjugate sets, arxiv preprint, March 13 2019. Appeared in M. Hospodár et al., eds., *DCFS 2019*, Springer, LNCS 11612, pp. 137–146, 2019.
6. Antonio Molina Lovett and Jeffrey Shallit, Optimal Regular Expressions for Permutations, in Christel Baier, Ioannis Chatzigiannakis, Paola Flocchini, and Stefano Leonardi, eds., *46th International Colloquium on Automata, Languages, and Programming (ICALP 2019)*, Leibniz International Proceedings in Informatics (LIPIcs), vol. 132, Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik, Dagstuhl, Germany, 2019, pp. 121:1-12. Available at http://drops.dagstuhl.de/opus/frontdoor.php?source_opus=10697.
7. P. Madhusudan, Dirk Nowotka, Aayush Rajasekaran, and Jeffrey Shallit, Lagrange’s theorem for binary squares, winner of the best paper award at *44rd International Symposium on Mathematical Foundations of Computer Science (MFCS 2018)*, Igor Potapov, Paul Spirakis, and James Worrell, eds., Article No. 18, Leibniz International Proceedings in Informatics Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany, 2018. pp. 18:1-14.

8. Therese Biedl, Ahmad Biniiaz, Robert Cummings, Anna Lubiw, Florin Manea, Dirk Nowotka, and Jeffrey Shallit, Rollercoasters and caterpillars, *ICALP 2018*, LIPICS conference proceedings, 18:1–18:15.
9. Charles J. Colbourn, Ryan E. Dougherty, Thomas F. Lidbetter, and Jeffrey Shallit, Counting Subwords and Regular Languages, arxiv preprint, April 30 2018. Appeared in M. Hoshi and S. Seki, eds., *DLT 2018*, LNCS Vol. 11088, Springer, 2018, pp. 231–242.
10. Jason Bell, Thomas Finn Lidbetter, and Jeffrey Shallit, Additive Number Theory via Approximation by Regular Languages, arxiv preprint, April 23 2018. Appeared in M. Hoshi and S. Seki, eds., *DLT 2018*, LNCS Vol. 11088, Springer, 2018, pp. 121–132.
11. Aayush Rajasekaran, Jeffrey Shallit, and Tim Smith, Sums of Palindromes: an Approach via Automata, in Rolf Niedermeier and Brigitte Vallee, eds., *35th Symposium on Theoretical Aspects of Computer Science (STACS 2018)*, Article No. 54; pp. 54:1-12.
12. Aayush Rajasekaran, Narad Rampersad, Jeffrey Shallit: Overpals, Underlaps, and Underpals. *WORDS 2017*: 17–29.
13. Dmitry Chistikov, Szabolcs Iván, Anna Lubiw, Jeffrey Shallit: Fractional Coverings, Greedy Coverings, and Rectifier Networks. *STACS 2017*: 23:1–23:14.
14. Jörg Endrullis, Jeffrey Shallit, and Tim Smith: Undecidability and Finite Automata. *DLT 2017*: 160–172.
15. Stepan Holub and Jeffrey Shallit: Periods and Borders of Random Words. *STACS 2016*: 44:1-44:10.
16. Daniel Goc, Hamoon Mousavi, Luke Schaeffer, Jeffrey Shallit, A New Approach to the Paperfolding Sequences, in Arnold Beckmann, Victor Mitran, Mariya Soskova, eds., *Evolving Computability: 12th Conference on Computability in Europe, CiE 2015*, Springer, LNCS, Vol. 9136, 2015, pp. 34–43.
17. H. Mousavi and J. Shallit, Mechanical Proofs of Properties of the Tribonacci Word, in F. Manea and D. Nowotka, eds., *WORDS 2015*, LNCS 9304, Springer, 2015, pp. 1–21.
18. Paul Bell, Daniel Reidenbach, Jeffrey Shallit, Factorization in formal languages, in I. Potapov, ed., *DLT 2015*, LNCS 9168, Springer, 2015, pp. 97–107.
19. Chen Fei Du and Jeffrey Shallit, Similarity density of the Thue-Morse word with overlap-free infinite binary words, in *Proc. AFL 2014* conference, pp. 231–245. Acceptance rate: 63.6%.
20. Jeffrey Shallit, Decidability and enumeration for automatic sequences: a survey, in A. A. Bulatov and A. M. Shur, eds., *CSR 2013*, LNCS 7913, Springer, 2013, pp. 49–63. An invited talk.

21. Shuo Tan and Jeffrey Shallit, Sets represented as the length- n factors of a word. In Juhani Karhumäki, Arto Lepistö, and Luca Zamboni, eds., *Combinatorics on Words: 9th International Conference, WORDS 2013, Turku, Finland, September 16-20, Proceedings*, Lecture Notes in Computer Science, Vol. 8079, Springer, 2013, pp. 250–261. Acceptance rate: 46.5%.
22. Hamoon Mousavi and Jeffrey Shallit, Shortest repetition-free words accepted by automata. In Helmut Jurgensen and Rogerio Reis, *Descriptive Complexity of Formal Systems: 15th International Workshop, DCFS 2013, London, Canada, July 22–25, 2013, Proceedings*, Lecture Notes in Computer Science, Vol. 8031, Springer, 2013, pp. 182–193.
23. Daniel Goc, Luke Schaeffer, and Jeffrey Shallit, Subword complexity and k -synchronization, In Marie-Pierre Béal and Olivier Carton, eds., *Developments in Language Theory, 17th International Conference, DLT 2013, Marne-la-Vallée, France, June 18-21, 2013. Proceedings*, Lecture Notes in Computer Science, Volume 7907, Springer, 2013, pp. 252–263. Acceptance rate: 54%.
24. Hamoon Mousavi and Jeffrey Shallit, Repetition avoidance in circular factors. In Marie-Pierre Béal and Olivier Carton, eds., *Developments in Language Theory 17th International Conference, DLT 2013, Marne-la-Vallée, France, June 18-21, 2013. Proceedings*, Lecture Notes in Computer Science, Volume 7907, Springer, 2013, pp. 384–395. Acceptance rate: 54%.
25. Daniel Goc, Hamoon Mousavi, and Jeffrey Shallit, On the number of unbordered factors. In A.-H. Dediu, C. Martin-Vide, and B. Truthe, eds., *LATA 2013*, LNCS 7810, 2013, pp. 299–310. Acceptance rate: 46.4%
26. Daniel Goc, Kalle Saari, and Jeffrey Shallit, Primitive words and Lyndon words in automatic and linearly recurrent sequences. In A.-H. Dediu, C. Martin-Vide, and B. Truthe, eds., *LATA 2013*, LNCS 7810, Springer, 2013, pp. 311–322. Acceptance rate: 46.4%
27. E. Rowland and J. Shallit, k -automatic sets of rational numbers, In *Language and Automata Theory and Applications, LATA 2012*, Lect. Notes in Comput. Sci., Vol. 7183, Springer, 2012, pp. 490–501. (35% acceptance rate)
28. G. Jirásková and J. Shallit, The state complexity of star-complement-star. In H.-C. Yen and O. H. Ibarra, eds., *Developments in Language Theory — 16th International Conference, DLT 2012*, Lect. Notes in Computer Science, Vol. 7410, Springer, 2012, pp. 380–391. (76% acceptance rate)
29. D. Henshall, J. Shallit, and D. Goč, Automatic theorem-proving in combinatorics on words. In N. Moreira and R. Reis, eds., *CIAA 2012*, Lect. Notes in Computer Science, Vol. 7381, Springer, 2012, pp. 180–191. (52% acceptance rate)

Preprints:

1. F. Michel Dekking, Jeffrey Shallit, and N. J. A. Sloane, Queens in exile: non-attacking queens on infinite chess boards, arxiv preprint, July 22 2019. Submitted
2. Daniel Gabric, Jeffrey Shallit, Borders, Palindrome Prefixes, and Square Prefixes, arxiv preprint, June 9 2019. Submitted.
3. Lucas Mol, Narad Rampersad, Jeffrey Shallit, and Manon Stipulanti, Cobham's Theorem and Automaticity, arxiv preprint 1809.00679, December 2018. Submitted.
4. Aaron Potechin and Jeffrey Shallit, Lengths of Words Accepted by Nondeterministic Finite Automata, arxiv preprint, February 13 2018. Submitted.
5. Narad Rampersad and Jeffrey Shallit, Common factors in automatic and Sturmian sequences, arxiv preprint, February 11 2018. Submitted.
6. Jeffrey Shallit and Arseny M. Shur, Subword complexity and power avoidance, arxiv preprint, January 16 2018. Submitted.